CLAIMS

1. A method of generating steering matrices used for spatial processing in a wireless multi-antenna communication system, comprising:

obtaining a base matrix;

selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value; and

forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars.

2. The method of claim 1, further comprising:

forming a plurality of steering vectors with columns of the at least one steering matrix.

3. The method of claim 1, wherein the base matrix is a Walsh matrix.

4. The method of claim 1, wherein the base matrix is a Fourier matrix.

5. The method of claim 1, wherein the base matrix is a unitary matrix having orthogonal columns.

6. The method of claim 1, wherein each of the at least one steering matrix has orthogonal columns.

7. The method of claim 1, wherein scalars for the at least one different combination are selected from a set comprising +1, –1, +*j*, and –*j*, where *j* is a square root of –1.

8. The method of claim 1, wherein each element of the at least one steering matrix belongs in a set comprising +1, –1, +*j*, and –*j*, where *j* is a square root of –1.

9. The method of claim 1, wherein each of the at least one steering matrix includes elements having equal magnitude.

10. The method of claim 1, wherein the base matrix has a dimension of N by N, where N is an integer greater than one, and wherein each combination includes N – 1 scalars for N – 1 rows of the base matrix.

11. The method of claim 10, wherein N is a power of two.

12. The method of claim 1, wherein the at least one combination of scalars is obtained with a base-K counter having one digit for each of the at least one scalar in a combination, where K is the number of different possible scalars usable for each row of the base matrix.

13. An apparatus operable to generate steering matrices used for spatial processing in a wireless multi-antenna communication system, comprising:

a controller operative to

obtain a base matrix,

select at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value, and

form at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars; and

a memory operative to store the base matrix, or the at least one steering matrix, or both the base matrix and the at least one steering matrix.

14. The apparatus of claim 13, wherein the base matrix is a Walsh matrix.

15. The apparatus of claim 13, wherein each of the at least one steering matrix has orthogonal columns.

16. The apparatus of claim 13, wherein each element of the at least one steering matrix belongs in a set comprising +1, –1, +*j*, and –*j*, where *j* is a square root of –1.

17. An apparatus operable to generate steering matrices used for spatial processing in a wireless multi-antenna communication system, comprising:

means for obtaining a base matrix;

means for selecting at least one different combination of scalars, each combination including at least one scalar for at least one row of the base matrix, one scalar per row, each scalar being a real or complex value; and

means for forming at least one steering matrix by multiplying the base matrix with the at least one different combination of scalars, wherein one steering matrix is formed by each combination of scalars.

18. The apparatus of claim 17, wherein the base matrix is a Walsh matrix.

19. The apparatus of claim 17, wherein each of the at least one steering matrix has orthogonal columns.

20. The apparatus of claim 17, wherein each element of the at least one steering matrix belongs in a set comprising +1, –1, +*j*, and –*j*, where *j* is a square root of –1.

21. A method of performing spatial processing at a transmitting entity for data transmission in a wireless multi-antenna communication system, comprising:

processing data to obtain a block of data symbols to be transmitted in a plurality of transmission spans;

obtaining a plurality of steering matrices, one steering matrix for each of the plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each

combination including at least one scalar used to multiply at least one row of the base matrix to generate a corresponding steering matrix; and

performing spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices.

22. The method of claim 21, wherein the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands.

23. The method of claim 21, wherein the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein each of the plurality of transmission spans corresponds to one or more subbands in one time interval.

24. The method of claim 21, wherein the plurality of transmission spans correspond to a plurality of time intervals.

25. The method of claim 21, wherein each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span.

26. The method of claim 21, wherein each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span.

27. The method of claim 21, wherein the base matrix is a Walsh matrix.

28. The method of claim 21, wherein the base matrix is a Fourier matrix.

29. The method of claim 21, wherein each of the plurality of steering matrices has orthogonal columns.

30. The method of claim 21, wherein each element of the plurality of steering matrices belongs in a set comprising +1, –1, +*j*, and –*j*, where *j* is a square root of –1.

31. The method of claim 21, wherein each of the plurality of steering matrices includes elements having equal magnitude.

32. The method of claim 21, wherein the plurality of steering matrices are unknown to a receiving entity for the block of data symbols.

33. The method of claim 21, wherein the plurality of steering matrices are known only to the transmitting entity and a receiving entity for the block of data symbols.

34. An apparatus at a transmitting entity in a wireless multi-antenna communication system, comprising:

a data processor operative to process data to obtain a block of data symbols to be transmitted in a plurality of transmission spans;

a controller operative to obtain a plurality of steering matrices, one steering matrix for each of the plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each combination including at least one scalar used to multiply at least one row of the base matrix to generate a corresponding steering matrix; and

a spatial processor operative to perform spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices.

35. The apparatus of claim 34, wherein each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span.

36. The apparatus of claim 34, wherein each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span.

37. The apparatus of claim 34, wherein the base matrix is a Walsh matrix.

38. The apparatus of claim 34, wherein each element of the plurality of steering matrices belongs in a set comprising +1, −1, $+j$, and $-j$, where j is a square root of −1.

39. An apparatus at a transmitting entity in a wireless multi-antenna communication system, comprising:

means for processing data to obtain a block of data symbols to be transmitted in a plurality of transmission spans;

means for obtaining a plurality of steering matrices, one steering matrix for each of the plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each combination including at least one scalar used to multiply at least one row of the base matrix to generate the corresponding steering matrix; and

means for performing spatial processing on at least one data symbol to be transmitted in each transmission span with the steering matrix obtained for the transmission span, the spatial processing resulting in the block of data symbols observing a plurality of effective channels formed with the plurality of steering matrices.

40. The apparatus of claim 39, wherein each steering matrix has one column, and wherein one data symbol is transmitted in each transmission span.

41. The apparatus of claim 39, wherein each steering matrix has multiple columns, and wherein multiple data symbols are transmitted simultaneously in each transmission span.

42. A method of performing receiver spatial processing at a receiving entity in a wireless multi-antenna communication system, comprising:

deriving a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices, one steering matrix for each of a plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each combination including at least one scalar used to multiply at least one row of the base matrix to generate a corresponding steering matrix;

obtaining, in the plurality of transmission spans, R sequences of received symbols via R receive antennas, where R is an integer one or greater; and

performing receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols.

43. The method of claim 42, wherein the multi-antenna communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the plurality of transmission spans correspond to a plurality of subbands.

44. The method of claim 42, wherein the plurality of transmission spans correspond to a plurality of time intervals.

45. The method of claim 42, wherein each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one.

46. The method of claim 42, wherein each steering matrix has N columns, and wherein each spatial filter matrix has a dimension of N by R, where N and R are integers greater than two.

47. An apparatus at a receiving entity in a wireless multi-antenna communication system, comprising:

a controller operative to derive a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices, one steering matrix for

each of a plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each combination including at least one scalar used to multiply at least one row of the base matrix to generate the corresponding steering matrix; and

a spatial processor operative to

obtain, in the plurality of transmission spans, R sequences of received symbols via R receive antennas, where R is an integer one or greater, and

perform receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols.

48. The apparatus of claim 47, wherein each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one.

49. The apparatus of claim 47, wherein each steering matrix has N columns, and wherein each spatial filter matrix has a dimension of N by R, where N and R are integers greater than two.

50. An apparatus at a receiving entity in a wireless multi-antenna communication system, comprising:

means for deriving a plurality of spatial filter matrices based on a channel response estimate and a plurality of steering matrices, one steering matrix for each of a plurality of transmission spans, wherein the plurality of steering matrices are generated based on a base matrix and at least one different combination of scalars, each combination including at least one scalar used to multiply at least one row of the base matrix to generate a corresponding steering matrix;

means for obtaining, in the plurality of transmission spans, R sequences of received symbols via R receive antennas, where R is an integer one or greater; and

means for performing receiver spatial processing on the R sequences of received symbols with the plurality of spatial filter matrices to obtain detected symbols.

51. The apparatus of claim 50, wherein each steering matrix has one column, and wherein each spatial filter matrix has a dimension of one by one.

52. The apparatus of claim 50, wherein each steering matrix has N columns, and wherein each spatial filter matrix has a dimension of N by R, where N and R are integers greater than two.